3rd Grade Unit 1: Force and Motion

Content Area: **Science**
Course(s):
Time Period: **MP1**
Length: **11 days**
Status: **Published**

NJSLS - Science

SCI.3-5-ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
SCI.3-PS2-1	Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
SCI.3-5-ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
SCI.3-PS2-2	Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.
SCI.3-5-ETS1-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Science and Engineering Practices

Planning and Carrying Out Investigations

Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. (3-PS2-1)

Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (3-PS2-2)

Asking Questions and Defining Problems

Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost. (3-5-ETS1-1)

Constructing Explanations and Designing Solutions

Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design problem. (3-5-ETS1-2)

Disciplinary Core Ideas

PS2.A: Forces and Motion

Each force acts on one particular object and has both strength and a direction. An object at rest typically has multiple forces acting on it, but they add to give zero net force on the object. Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Boundary: Qualitative and conceptual, but not quantitative addition of forces are used at this level.) (3-PS2-1)

The patterns of an object's motion in various situations can be observed and measured; when that past motion exhibits a regular pattern, future motion can be predicted from it. (Boundary: Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.) (3-PS2-2)

PS2.B: Types of Interactions

Objects in contact exert forces on each other. (3-PS2-1)

ETS1.A: Defining and Delimiting Engineering Problems

Possible solutions to a problem are limited by available materials and resources (constraints). The success of a designed solution is determined by considering the desired features of a solution (criteria). Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)

ETS1.B: Developing Possible Solutions

Research on a problem, such as climate change, should be carried out before beginning to design a solution. Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)

At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs. (3-5-ETS1-2)

Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved. (3-5-ETS1-3)

ETS1.C: Optimizing the Design Solution

Different solutions need to be tested in order to determine which of them best solves the problem, given the

criteria and the constraints. (3-5-ETS1-3)

Crosscutting Concepts

Patterns

Patterns of change can be used to make predictions. (3-PS2-2)

Cause and Effect

Cause and effect relationships are routinely identified. (3-PS2-1)

Science Knowledge is Based on Empirical Evidence

Science findings are based on recognizing patterns. (3-PS2-2)

Scientific Investigations Use a Variety of Methods

Science investigations use a variety of methods, tools, and techniques. (3-PS2-1)

Influence of Engineering, Technology, and Science on Society and the Natural World

People’s needs and wants change over time, as do their demands for new and improved technologies. (3-5-ETS1-1)

Engineers improve existing technologies or develop new ones to increase their benefits, decrease known risks, and meet societal demands. (3-5-ETS1-2)

Rationale and Transfer Goals

How do equal and unequal forces on an object affect the object?

In this unit of study, students are able to determine the effects of balanced and unbalanced forces on the motion of an object. The crosscutting concepts of patterns and cause and effect are identified as organizing concepts for these disciplinary core ideas. In the third-grade performance expectations, students are expected to demonstrate grade-appropriate proficiency by planning and carrying out investigations. Students are expected to use these practices to demonstrate an understanding of the core ideas.

Enduring Understandings

The motion of an object is affected by forces.

Energy can be stored, transferred, and transformed but cannot be destroyed.

Essential Questions

How do scientists play soccer?

Can we use patterns that we observed to predict the future?

Content - What will students know?

- Science investigations use a variety of methods, tools, and techniques.
- Cause-and-effect relationships are routinely identified.
- Objects in contact exert forces on each other.
- Each force that acts on a particular object has both strength and a direction.
- An object at rest typically has multiple forces acting on it, but they add to zero net force on the object.
- Forces that do not sum to zero can cause changes in the object's speed or direction of motion. (Qualitative and conceptual, but not quantitative, addition of forces are used at this level.)

- Science findings are based on recognizing patterns.
- Patterns of change can be used to make predictions.
- The patterns of an object's motion in various situations can be observed and measured.
- When past motion exhibits a regular pattern, future motion can be predicted from it. (Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)

Skills - What will students be able to do?

- Identify cause-and-effect relationships that are routinely identified.
- Plan and conduct investigations collaboratively to produce data to serve as the basis for evidence.
- Use fair tests in which variables are controlled and the number of trials considered.
- Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
- Make predictions using patterns of change.
- Make observations and/or measurements to produce data to serve as the basis of evidence for an explanation of a phenomenon.
- Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

Activities - How will we teach the content and skills?

- Mystery Science Invisible Forces Anchor Phenomenon
- Mystery Science Invisible Forces Lesson 1
- Mystery Science Invisible Forces Lesson 2
- Mystery Science Invisible Lesson 3
- Whole group instruction and discussion.
- Read Alouds
- Group and Individual Projects

- Hands-on discovery when possible; creating models
- Webquests/Internet “field trips”

Evidence/Assessments - How will we know what students have learned?

- Mystery Science Invisible Forces Lesson 1 Assessment
- Mystery Science Invisible Forces Lesson 2 Assessment
- Mystery Science Invisible Forces Lesson 3 Assessment
- Teacher Observation
- Student projects/models
- Exit Tickets
- Tests/Quizzes
- Grade 3 Science Benchmark #1 (taken after Unit 2)

Spiraling for Mastery

Content or Skill for this Unit	Spiral Focus from Previous Unit	Instructional Activity
• Objects in contact exert forces on each other. • Each force that acts on a particular object has both strength and a direction. • An object at rest typically has multiple forces acting on it, but they add to zero net force on the object. • Forces that do not sum to zero can cause changes in the object’s speed or direction of motion. (Qualitative and conceptual, but not quantitative, addition of	Kindergarten: Pushes and pulls can have different strengths and directions. Kindergarten: Pushing or pulling on an object can change the speed or direction of the object’s motion and can start or stop it. Kindergarten: When objects touch or collide, they push on one another and can change motion. Kindergarten: A bigger push or	K-PS2-1 Activities K-PS2-2 Activities

forces are used at this level.) • Science findings are based on recognizing patterns. • Patterns of change can be used to make predictions. • The patterns of an object's motion in various situations can be observed and measured. • When past motion exhibits a regular pattern, future motion can be predicted from it. (Technical terms, such as magnitude, velocity, momentum, and vector quantity, are not introduced at this level, but the concept that some quantities need both size and direction to be described is developed.)	pull causes things to speed up or slow down more quickly. Kindergarten: Patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted.	

Key Resources

Mystery Science

Robo Arm

Student Interactives

21st Century Life and Careers

WRK.9.2.5.CAP.3	Identify qualifications needed to pursue traditional and non-traditional careers and occupations.
WRK.9.2.5.CAP.4	Explain the reasons why some jobs and careers require specific training, skills, and certification (e.g., life guards, child care, medicine, education) and examples of these requirements.

Career Readiness, Life Literacies, & Key Skills

TECH.9.4.5.CI.1	Use appropriate communication technologies to collaborate with individuals with diverse perspectives about a local and/or global climate change issue and deliberate about possible solutions (e.g., W.4.6, 3.MD.B.3,7.1.NM.IPERS.6).
TECH.9.4.5.CI.2	Investigate a persistent local or global issue, such as climate change, and collaborate with individuals with diverse perspectives to improve upon current actions designed to address the issue (e.g., 6.3.5.CivicsPD.3, W.5.7).
TECH.9.4.5.IML.3	Represent the same data in multiple visual formats in order to tell a story about the data.

Interdisciplinary Connections/Companion Standards

NJSLS ELA

RI.3.1 Ask and answer questions, and make relevant connections to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers. (3-PS2-1)

W.3.7 Conduct short research projects that build knowledge about a topic. (3-PS2-1, 3-PS2-2)

W.3.8 Recall information from experiences or gather information from print and digital sources; take brief notes on sources and sort evidence into provided categories. (3-PS2-1, 3-PS2-2)

NJSLS Mathematics

MP.2 Reason abstractly and quantitatively. (3-PS2-1)

MP.5 Use appropriate tools strategically. (3-PS2-1)

3.MD.A.2 Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l). Add, subtract, multiply, or divide to solve one-step word problems involving masses or volumes that are given in the same units, e.g., by using drawings (such as a beaker with a measurement scale) to represent the problem. (3-PS2-1)

English Language Arts

In order to integrate the CCSS for ELA into this unit, students need opportunities to read content-specific texts to deepen their understanding of force and motion. As they read, teachers should pose questions such as, "What interactions can you identify between the objects in the text?" and "What patterns of motion are described in the text?" Students should be encouraged to answer questions and cite evidence from the text to support their thinking. To further support the integration of the ELA standards, students can also conduct short research projects about simple force-and-motion systems and the interactions that occur among forces and objects within the systems. For example, students could be asked to conduct a short study by bouncing a ball 10 times and identifying the patterns they observe. Next students could predict, based on the patterns they saw, what would happen if they bounced the ball 10 more times. Students then could draw a model of the force and motion system, identifying the structures and forces that interact within the system. This would also give students the opportunity to develop note-taking skills and use multiple sources to collect information about force and motion.

Mathematics

In order to integrate the Common Core State Standards for Mathematics, students can use measurement tools in a variety of ways to conduct investigations. Students could find the mass of an object in order to understand that the heavier something is, the greater the force needed to cause a change in its motion. Students could use rulers or tape measures to measure the distance an object moves. Students can then record and analyze their data to determine patterns of change and explain cause-and-effect relationships, while reasoning abstractly and quantitatively.